PCT/IB 04/ 51336 NL 030946

Europäisches Patentamt	European Patent Office	Office européen des brevets

Bescheinigung | Certificate | Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

03102482.1

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

Europäisches Patentamt | European Patent Office | Office européen des brevets

Anmeldung Nr:
Application no.: 03102482.1
Demande no:

Anmeldetag:
Date of filing: 08.08.03
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

Koninklijke Philips Electronics N.V.
Groenewoudseweg 1
5621 BA Eindhoven
PAYS-BAS

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Shallow loudspeaker

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

H04R/

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL
PT RO SE SI SK TR LI

Shallow loudspeaker

The invention relates to a loudspeaker which is provided with a frame, a membrane and a drive unit.

Such speakers are generally known. In Figure 12 of the accompanying drawing a known loudspeaker is depicted. This speaker has a frame (1), a membrane (2) and an electromagnetic driving unit (4). The membrane is formed by a conical body (2a) and has a flat outer circumferential edge (2b) and a flat inner circumferential edge (2c). The driving unit is provided with a stationary part (4a) and a movable part (4b). The stationary part, which includes a permanent magnet and a magnetic yoke, is secured to the frame. The movable part includes a voice coil and a cylindrical coil support (4b1). The membrane is at its outer circumferential edge connected to the frame by means of a flexible suspension (6) and is at its inner circumferential adhered to the coil support, which in its turn is connected to the frame by means of a spider (8).

The conventional conical body of the membrane of the depicted known loudspeaker has a certain height in order to obtain sufficient stiffness. The membrane should have a certain minimal stiffness in order to be able to move like a piston for low frequency reproduction and to have a controlled behavior at and above the first break-up of the membrane for mid and high frequency reproduction. For this reason there arise problems relating to the speaker's performance if a shallow speaker, i.e. a speaker having a small height, is required in certain applications.

From JP-A 54-6523 a shallow speaker is known, which is provided with a faintly conical diaphragm having a corrugation structure for improving the behavior of the diaphragm. The diaphragm has an outer circumferential part glued to an elastic suspension ring and an inner circumferential part glued to a voice-coil bobbin. The corrugation structure is formed by radial corrugations which decrease towards the outer circumferential part and which increase towards the inner circumferential part. Due to this structure the outer circumferential part includes a flat ring-shaped outer edge glued to the suspension ring and the inner circumferential part includes an undulating inner edge glued to the bobbin.

Although the speaker known from JP-A 54-6523 comprises means to solve the above-mentioned problems relating to the performance, it causes a manufacturing problem, particularly as to the fixation of the corrugating diaphragm to the voice-coil bobbin.

An object of the invention is to provide a loudspeaker which can be given a small height without deteriorating its sound performance and without hampering its manufacture.

This object is achieved with the loudspeaker according to the invention which is provided with a frame, a membrane and a drive unit, the membrane having a substantially flat outer circumferential edge suspended from the frame, and a substantially flat inner circumferential edge, the driving unit having a stationary part secured to the frame and provided with a magnet system, and a translatable part provided with a coil support secured to the substantially flat inner circumferential edge of the membrane and comprising an electric coil, wherein the membrane includes a concave membrane body having, considered in a circumferential direction, a pattern of folds radially extending between the substantially flat inner circumferential edge and the substantially flat outer circumferential edge of the membrane. It is to be noted that the expression "substantially flat" has the meaning of flat or practically flat in this document. A deviation, if any, of flatness of the edges must be small compared with the maximal height and/or depth of the folds.

The loudspeaker according to the invention is provided with a membrane which is only undulated in an area extending between its substantially flat circumferential edges. Because of this measure the loudspeaker according to the invention is production-friendly because the circumferential edges are or are at least practically flat whereby the connection of the membrane with the frame and the fixation of the membrane to the coil support can take place in conventional ways generally known for mounting membranes having flat circumferential edges. It is common practice e.g. to glue a flat inner circumferential edge of a membrane to the coil support. In this context it is to be noted that the radial folds of the diaphragm applied into the speaker disclosed in JP-A 54-6523 are cut off as it were in the inner circumferential edge of the diaphragm, whereby this edge itself is undulating. It has appeared that it is difficult to glue such an undulating edge to a voice-coil bobbin. The way in which this has to be done is quite different from what present automated speaker-lines can handle. This means that the mounting of known undulating diaphragms requires extra investments in new glue-robots. A problem arising during positioning of the

diaphragm with regard to the voice-coil bobbin is e.g. that already a small inclination of the membrane causes such an offset between the tops and troughs of the undulated inner edge of the diaphragm that gliding of the diaphragm over the bobbin is hindered.

Because of the specific corrugated structure applied into the membrane body of the loudspeaker according to the invention, the membrane is reinforced over its surface and has sufficient stiffness to be suitable as swallow or flat membrane. The degree of undulations depends on the shape of the folds. The folds may be in principle of each shape, such as round or sharp, wherein the pattern may have tops and troughs. The pattern of folds may be uniform or non-uniform, seen in a circumferential direction.

A swallow loudspeaker provided with a membrane as above described has an excellent sound performance, due to its good behavior at and above the first break-up. In other words also at and above the break-up there is little distortion of the reproduced sound.

Preferably, the folds have a depth and/or height, measured from the membrane body, which smoothly decreases to the substantially flat outer circumferential edge and/or the substantially flat inner circumferential edge of the membrane.

In a practical embodiment the membrane body is a concave body, particularly a slightly concave body, the substantially flat inner circumferential edge and the substantially flat outer circumferential edge being in parallel planes. Preferably, the membrane body is cone-shaped. In general the inner circumferential edge is circular; the outer circumferential edge may be of a different form, such as more or less elliptical.

Another practical embodiment has the feature that the membrane body is an in principle flat body, the substantially flat inner circumferential edge and the substantially flat outer circumferential edge being in substantially coinciding planes.

It is practical to adhere the membrane to the movable part of the driving unit, particularly to the coil support thereof. For this purpose an existing glue may be used.

In certain applications it may be preferred to apply a non-uniform pattern of folds. Acoustical properties of the loudspeaker and/or mechanical properties of the membrane can be adjusted by varying the degree of non-uniformity. Moreover, several shapes of folds may be applicable.

It is to be noted that the loudspeaker according to the invention is suitable for sound reproduction in hifi, home, automotive, tv and multimedia systems and it is, as already said, particularly suitable for applications having very small built-in depths.

The invention also relates to a membrane as defined in Claim 9.

With regard to the Claims it is noted that various combinations of embodiments and features as described in the Claims are possible within the scope of the invention.

The invention will now be described in more detail, by way of example, with reference to the drawings, in which

Fig. 1 shows diagrammatically in a cross-section an embodiment of the loudspeaker according to the invention,

Fig. 2 is a diagrammatical perspective view of the membrane of the embodiment shown in Fig. 1,

Fig. 3 is a fold shape-fold distribution diagram of the membrane of the embodiment shown in Fig. 1,

Figs. 4 to 10 show diagrammatically in cross-sections variants of the embodiment 1 shown in Fig. 1,

Fig. 11 is a diagram displaying several suitable shapes of fold, and

Fig. 12 shows diagrammatically a conventional loudspeaker.

The loudspeaker depicted in the Figures 1 to 3 is provided with a frame 101, a membrane 103 and an electromagnetic drive unit 105. The membrane 103 has a shallow concave membrane body 104 provided with a flat outer circumferential edge 104a and a flat inner circumferential edge 104b and is provided with a pattern of radial folds 104c, which pattern extends over the surface of the membrane 104, seen in circumferential direction. The folds 104c, which are formed by tops, have a height (h) which increases from the outer edge 104a towards the inner edge 104b, the maximum height being located at some distance from the inner edge. The membrane body 104 may be made of e.g. paper, particularly reinforced paper. The drive unit 105 comprises a stationary part 106a and a movable, i.e. translatable, part 106b. The stationary part 106a is secured to the frame 101 and has a magnet system including a permanent magnet 107 and a magnetic yoke 107b, and the translatable part 106b has a coil system including a voice coil 108a and a coil former or support 108b on which the coil 108a is attached. The magnet system and the coil system can magnetically cooperate with each other through an air gap 109. The coil support 108b is adhered to the flat inner circumferential edge 104b by means of a suitable glue which may be a known glue.

The coil support 108b is connected to the frame 101 by means of a spider 122, in a way known per se.

The outer circumferential edge 104a is connected to the frame 101 by a resilient means 113, such as a roll-collar known per se and made of e.g. rubber or foam.

In this embodiment the folds 104c, which have a radial axis 105, smoothly attenuate on nearing the outer circumferential edge 104c. The folds 104c terminate in the vicinity of the inner edge 104b in such a way that the membrane body 104 can provide the desired flat inner edge.

In the Figs. 4 to 10 several further embodiments are shown. As far as possible the same reference signs are used for corresponding parts.

In the loudspeakers depicted in Figure 4 the membrane body 104 is provided with a ring-shaped recess 300, seen from the drive unit 105, in order to enlarge the stroke of the translatable part 106b of the drive unit 105. The recess 300 is located at some distance from the flat inner circumferential edge 104b. A variant of the recess 300 is applied into the membrane body 104 of the loudspeaker depicted in Figure 5. This recess, indicated by 400, borders the inner edge 104b. In this example the folds 104c smoothly attenuate towards the inner edge 104b. The membrane body 104 of the loudspeaker depicted in Figure 6 is provided with folds 104c shaped by troughs. A variant of this membrane body 104 is applied in the loudspeaker depicted in Figure 7. In this variant the structure of folds 104c is only provided in a restricted area between the edges 104 and 104b.

In contrast to the embodiments disclosed in the Figures 1 to 7, wherein the edges 104a and 204b are positioned in parallel planes which extend at a small distance from each other, the embodiment depicted in Figure 8 has a flat outer edge 104a and a flat inner edge 104b which are positioned in the same plane. The membrane body 104 is provided with a sinuating pattern of folds 104c, seen in a circumferential direction.

In the variants shown in the Figures 9 and 10 the folds of the structure of folds have an undulating pattern in radial direction.

The diagrammatical presentation in Fig. 11 displays several possible shapes of fold and shapes of membrane. The membranes, which are indicated by 103, have a substantially flat outer edge 104a and a substantially flat inner edge 104b. The folds, which carry the reference numeral 104c, may be regularly or irregularly distributed over the membrane face, dependent on the required properties of the membrane. The folds can have tops and/or troughs and thus having a height (h) and/or a depth (d) with regard to the membrane face. Several kinds of fold can be applied in combination, if desired.

It is to be noted that the disclosed embodiments are only given by way of example. Within the scope of the invention it is possible to combine different features of several embodiments to build a loudspeaker according to the invention.

CLAIMS:

1. A loudspeaker provided with a frame (1), a membrane (3) and a drive unit (5), the membrane having a substantially flat outer circumferential edge suspended from the frame, and a substantially flat inner circumferential edge, the driving unit having a stationary part secured to the frame and provided with a magnet system, and a translatable part provided with a coil support secured to the substantially flat inner circumferential edge of the membrane and comprising an electric coil, wherein the membrane includes a membrane body (4) having, considered in a circumferential direction, a pattern of folds (4c) radially extending between the substantially flat inner circumferential edge and the substantially flat outer circumferential edge of the membrane.

2. A loudspeaker as claimed in Claim 1, wherein the membrane body is a concave body, the substantially flat inner circumferential edge and the substantially flat outer circumferential edge being in parallel planes.

3. A loudspeaker as claimed in Claim 1, wherein the membrane body is an in principle flat body, the substantially flat inner circumferential edge and the substantially flat outer circumferential edge being in substantially coinciding planes.

4. A loudspeaker as claimed in Claim 1, wherein the substantially flat inner circumferential edge of the membrane is adhered to the coil support of the translatable part of the driving unit.

5. A loudspeaker as claimed in Claim 1, wherein the folds have a depth, measured from the membrane body, which smoothly decreases towards the substantially flat outer circumferential edge of the membrane.

6. A loudspeaker as claimed in Claim 1, wherein the folds have a depth, measured from the membrane body, which smoothly decreases towards the substantially flat inner circumferential edge of the membrane.

7. A loudspeaker as claimed in Claim 1, wherein the membrane edge has an inner portion adjoining the substantially flat inner circumferential edge of the membrane which portion recedes, seen from the magnet system.

8. A loudspeaker as claimed in Claim 1, wherein the pattern of folds is a non-uniform pattern, seen in a circumferential and/or radial direction.

9. A membrane presenting the features of the membrane disclosed in any one of the preceding Claims and thus constructed and evidently intended for use in the loudspeaker as claimed in any one of the preceding Claims.

ABSTRACT:

Loudspeaker provided with a frame (101), a membrane (103) and a drive unit (105). The membrane has a flat outer circumferential edge (104a) suspended from the frame and a flat inner circumferential edge (104b). The driving unit has a stationary part (106a) secured to the frame and a translatable part (106b) provided with a coil support (108b) secured to the inner circumferential edge of the membrane. The membrane includes a concave membrane body (104) having, considered in a circumferential direction, a pattern of folds radially extending between the flat inner circumferential edge and flat outer circumferential edge of the membrane, which pattern of folds improves the stiffness of the membrane.

Fig. (2)

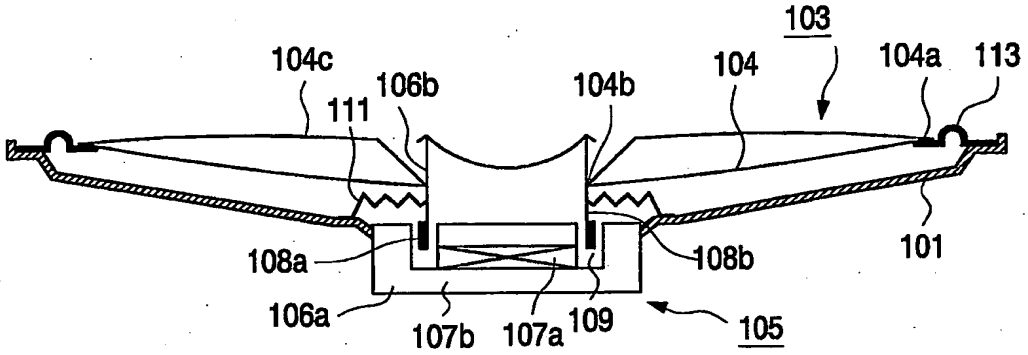

Fig.1

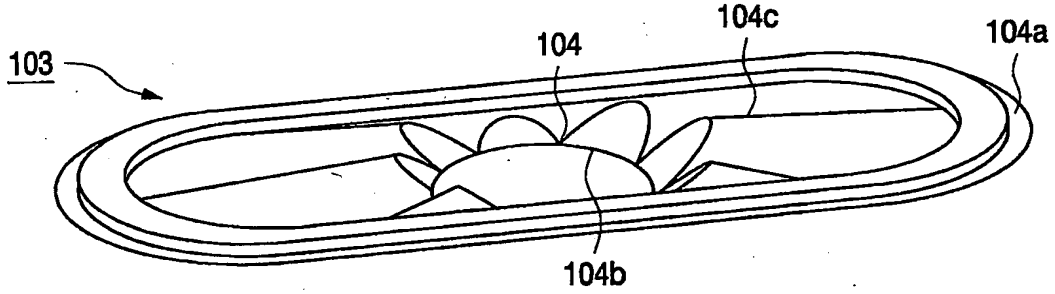

Fig.2

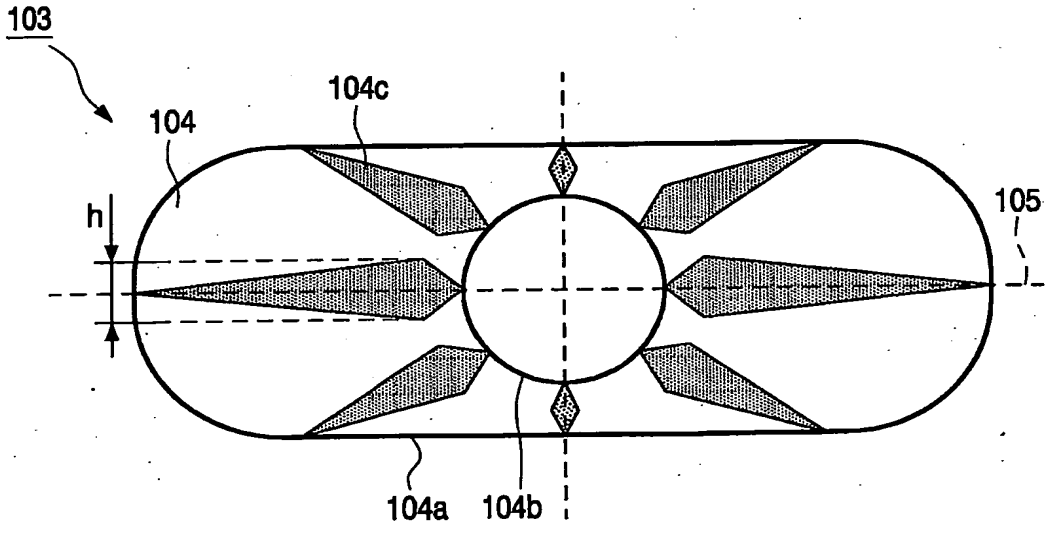

Fig.3

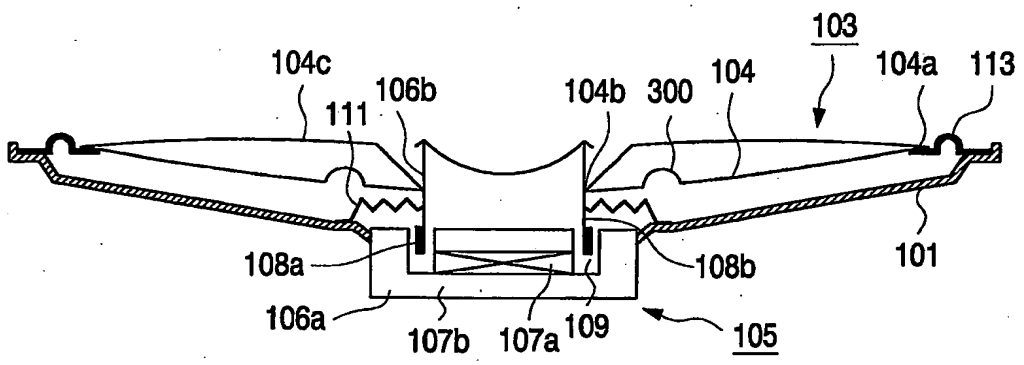

Fig.4

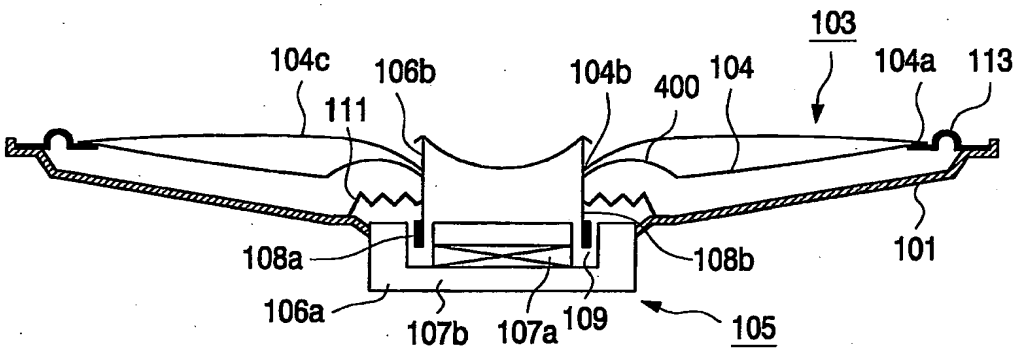

Fig.5

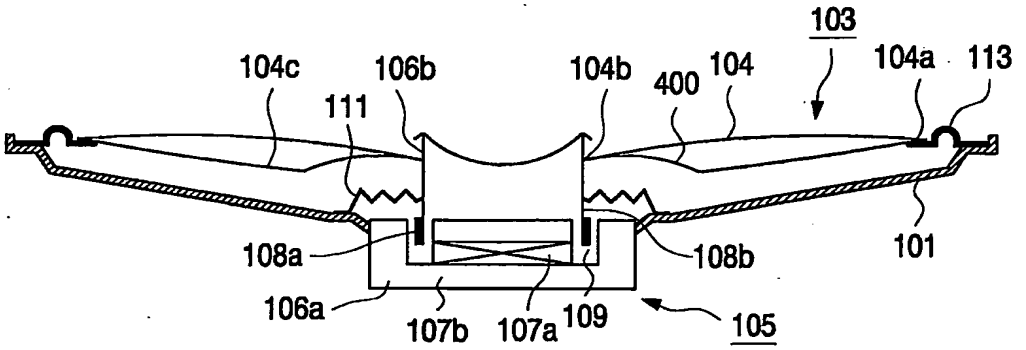

Fig.6

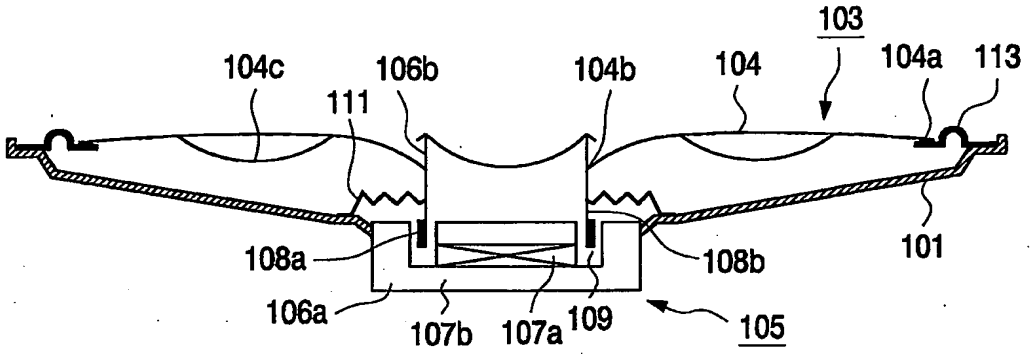

Fig.7

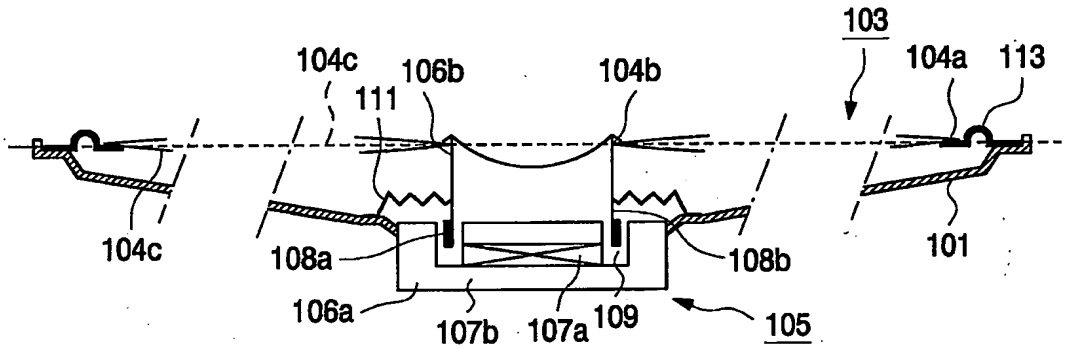

Fig.8

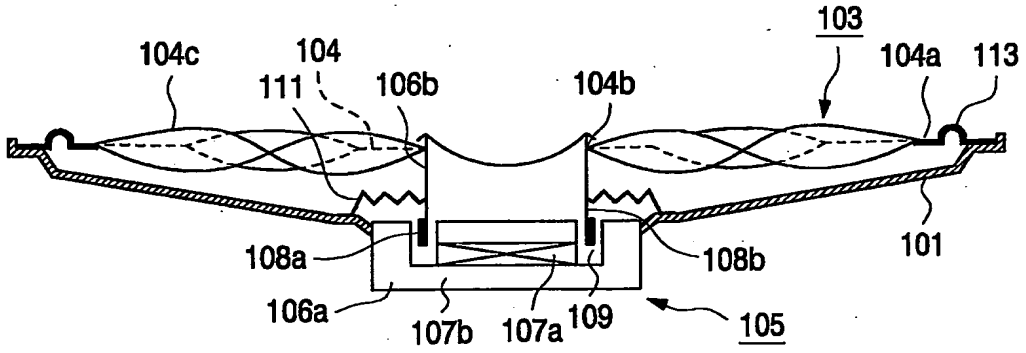

Fig.9

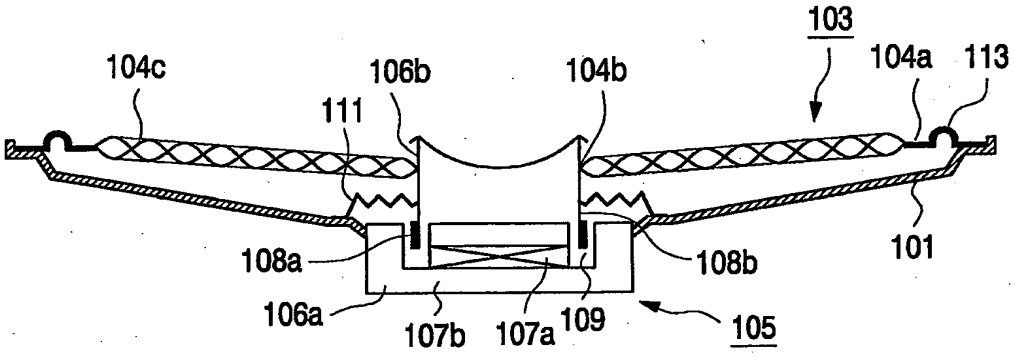
103
104c
106b
104b
104a
113
111
108a
108b
101
106a
107b
107a
109
105

Fig.10

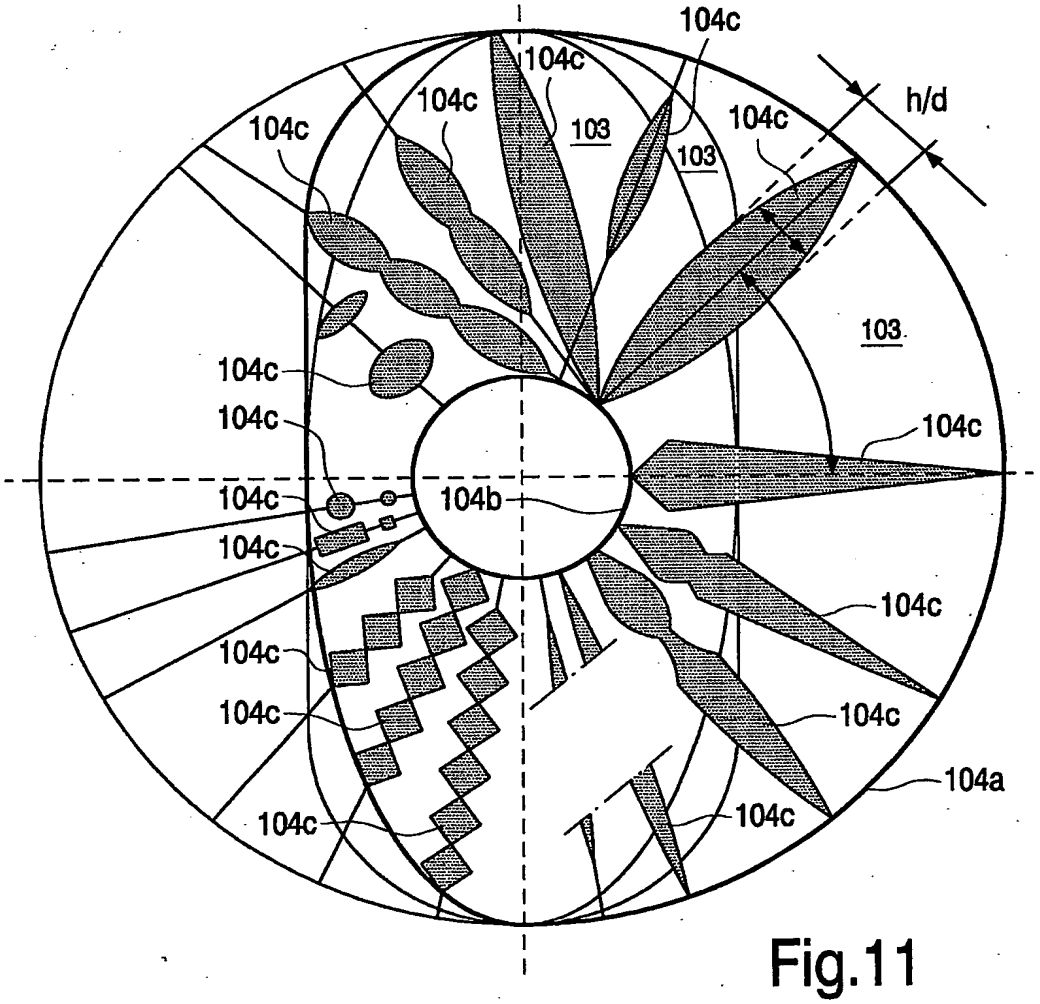
104c
104c
104c
104c
103
103
h/d
104c
103
104c
104c
104b
104c
104c
104c
104c
104c
104a
104c
104c

Fig.11

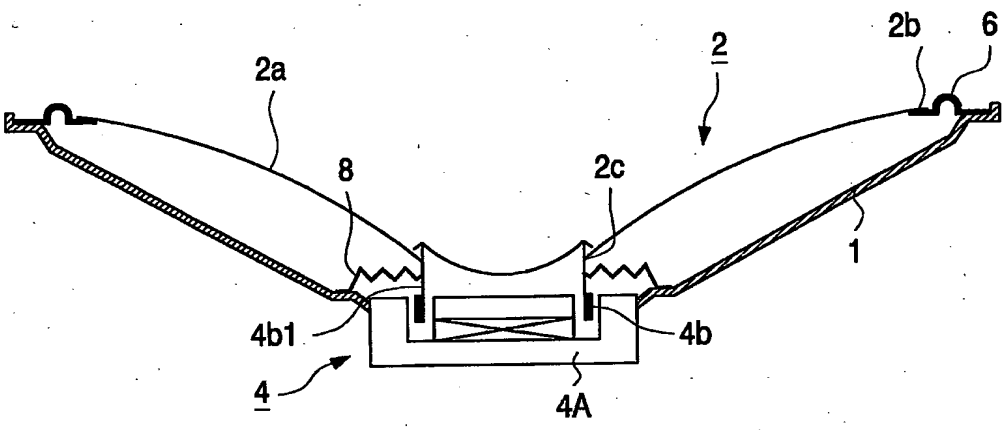

Fig.12